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Final Report

INTELLIGENT ROBOTICS ECE 4/579
Copernicus Head

My task for the term was to complete the facial mechanisms on the Copernicus robot head. This was a continuation of my work from the first term of the class.
I began creating eyes and eyelids for the robot, but had limited success mostly due to the irregular shape of the skull. Trying to create mechanisms that fit the organic shape of the head was extremely difficult and time consuming. It is for that reason that I decided that I would created all of the structures I needed in CAD so that they could be 3D printed and installed in the head. This meant that I would no longer have to account for the irregular curves in my designs.

I started with the eyelid and eye internal mechanisms and structure. These were the mechanisms that caused me the most trouble last term. I started by doing extremely detailed measurements of the inside of the head. This was very very difficult, as measuring irregular shapes is hard enough, but measuring them in a confined internal space is nearly impossible!

I spent 2 weeks measuring and re-measuring the skull as I began the CAD design of the structure that would hold the eyes and eyelids all together (fig.1). I had already created the eyelids last term (fig.2), so I had to be sure that the eyelids would fit in the structure within the skull. Another important element of this design was making the servos easily removable in case that they ever needed to be replaced. I created separate structures to hold the micro-servos that were held in place using small screws (fig. 3).

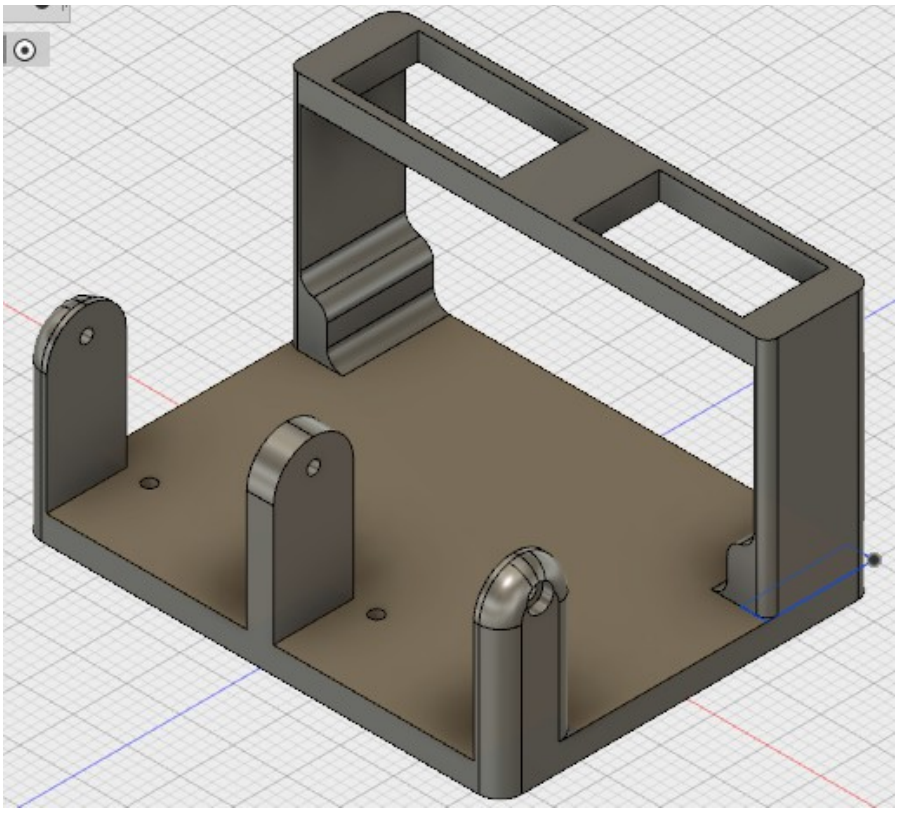


Fig.1: CAD drawing of the eyelid and eye internal structure.

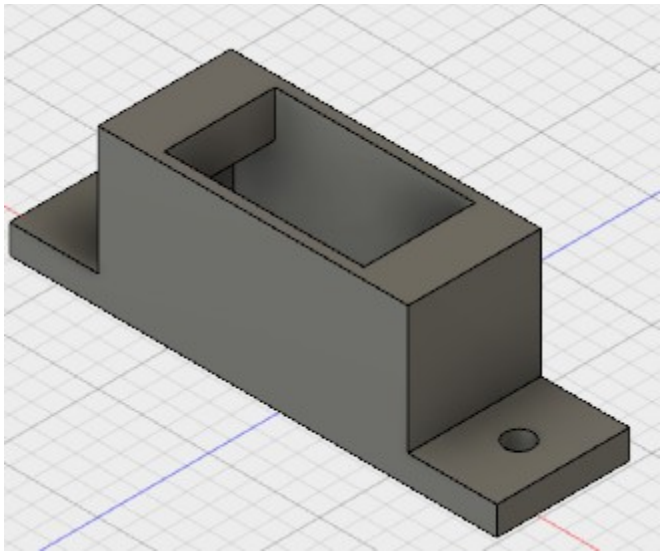


Fig. 2: CAD drawing of the micro-servo holder

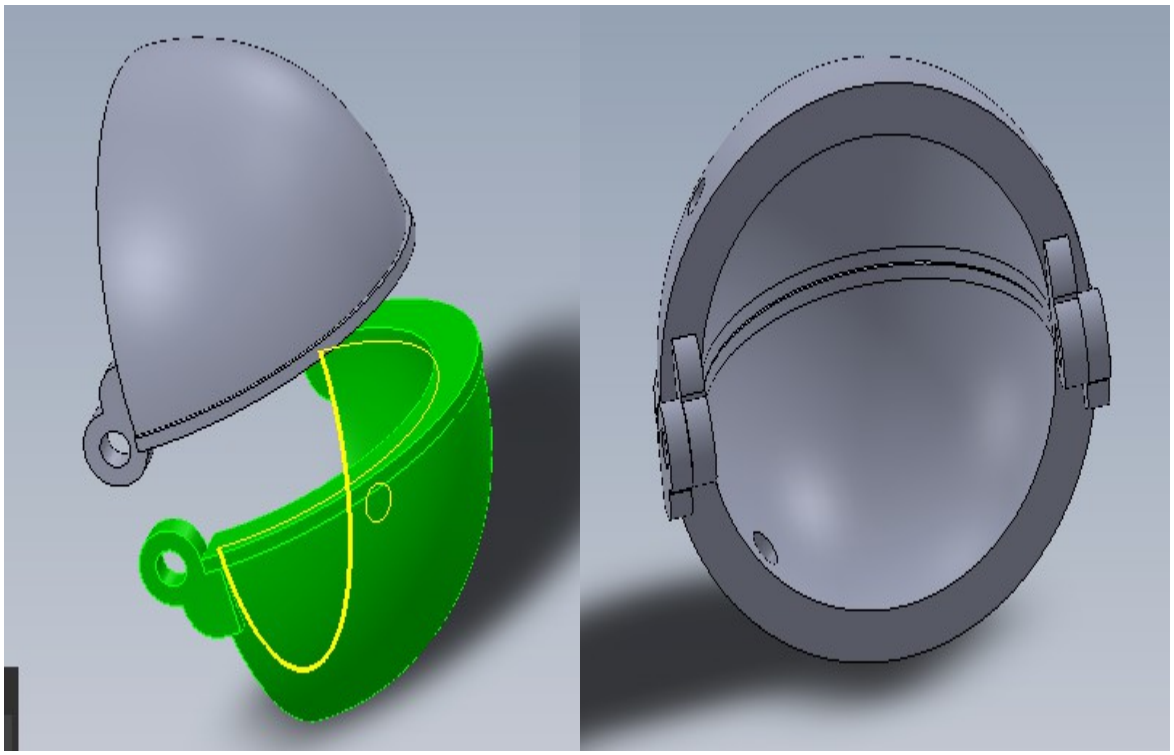


Fig. 3: CAD drawings of the eyelids created last term.

Once the files were to my liking, I had them 3D printed at the LID. This took about a week, as there were issues with the initial printing and it had to be re-printed. Once the structures were finally printed, I was able to install the two eyelid servos and the eyelids I printed last term (fig. 4).

Fig. 4: Eyelids and eyelid servos installed on the 3D printed structure.

My focus then shifted to the eyes and their servos. Using the 3D printed servo holders, I was able to install the eyes and give them horizontal movement using a revised eye design continued from last term (fig. 5). The eyeballs were then installed with the micro-servos onto the internal 3D printed structure (fig. 6).

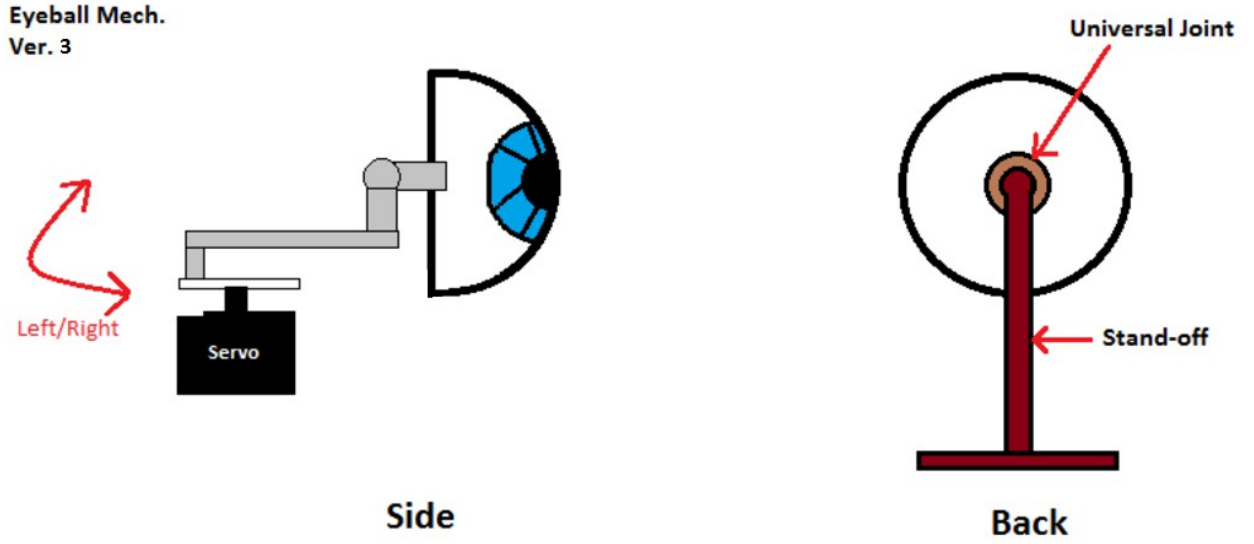


Fig. 5: Illustration of the eyeball motion mechanism.

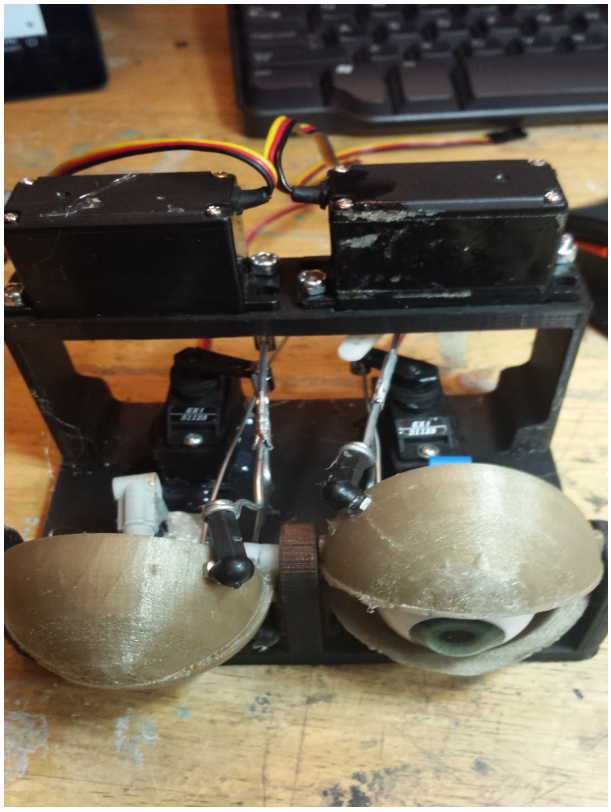


Fig. 6: Eyeballs and all motion servos installed on the internal 3D structure.

Because of the irregular shape of the skull, a dremel was used to cut holes in the sides of the face to allow for the structure to fit inside (fig. 7). This prevented internal collisions.

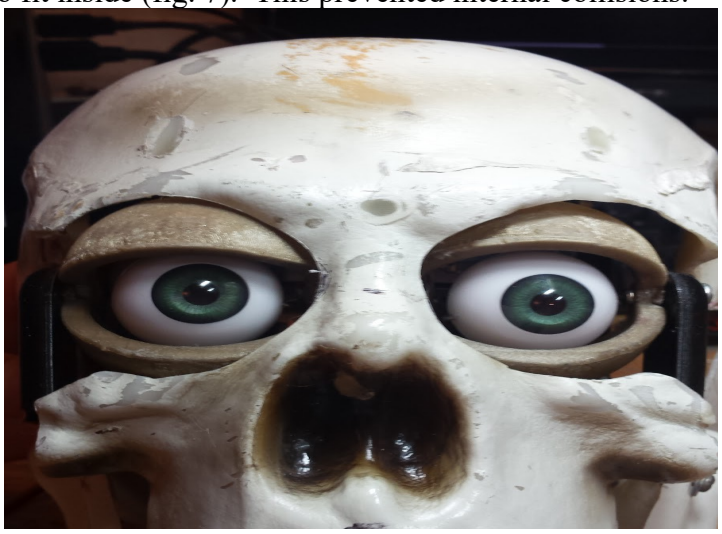


Fig. 7: Internal structure, eyelids, and eyes fit inside the skull.

I then turned my focus to the lips, which I had created in CAD last term (fig. 8). While the lips had worked well on a flat surface, it was time for me to see if I could get them to work on the curved surface of the skull. In order to make them fit the contour of the face, I used a heat gun to melt the lips to the shape of the jaw and mouth (fig. 9). I then began designing how the servos would fit in the jaw to control the left and right side of the mouth. These functions are essential to creating lips that can gesture in similar ways to that of human lips. Our ultimate goal is to create a program that converts texts into realistic mouth motions.

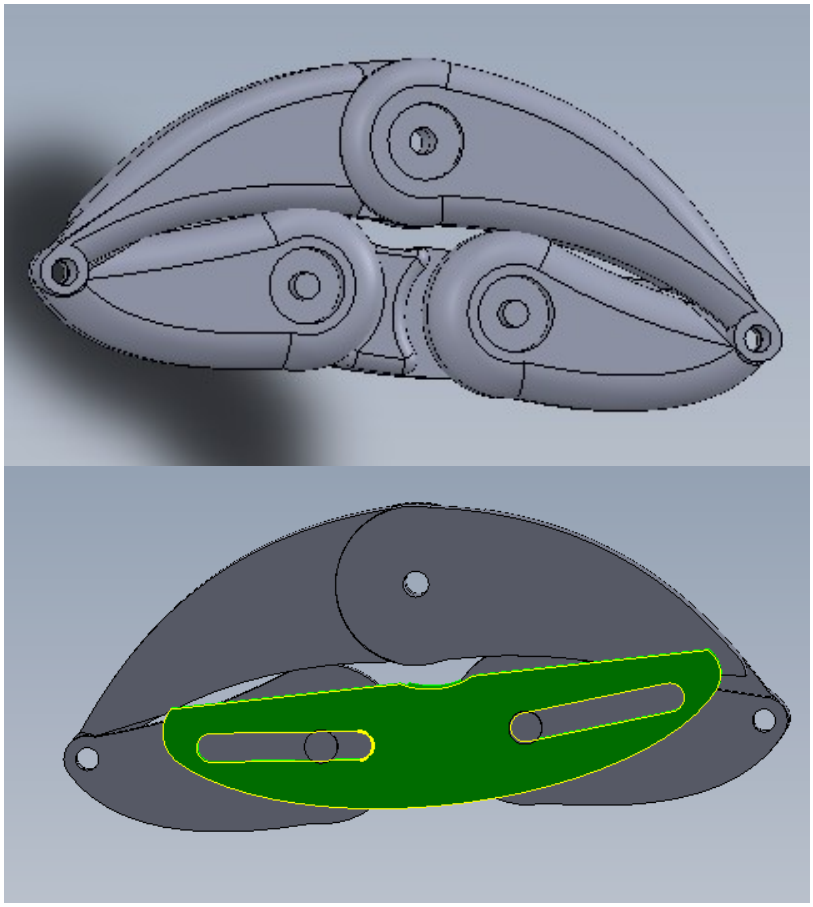


Fig. 8: CAD drawing of the front and back of the lip mechanism.

Fig. 9: Lip mechanism melted to shape of face and installed.

The servos I installed to control the mouth gestures were difficult, as there wasn't much space behind the jaw, and I needed servos that were strong enough to move the lips in the sliders, but still small enough to be hidden behind the jaw. If I had more time, I would spend it perfecting these mouth slider mechanisms, however given the time constraints, I am happy with the functionality of the mouth. A servo was also installed inside the head to open and close the mouth. This design utilized the already created opening and closing mouth mechanism that the robot came with but with some slight modifications. These three servos I installed control the entirety of the mouth gestures (fig. 10). This

was one of the more time consuming mechanism installations of them all due to the space limitations.

Fig. 10: The three mouth servos installed in the head.

The next task was to find a way to install the head onto the InMoov body. It was essential that the neck allowed for easy installation and removal. Using 3D printed neck pieces from last term, I created a bracket that connected to the head internally that could be removed by simply removing two screws (fig. 11). This design also allows for spacers to be added if the neck needs to be elongated in relation to the head.

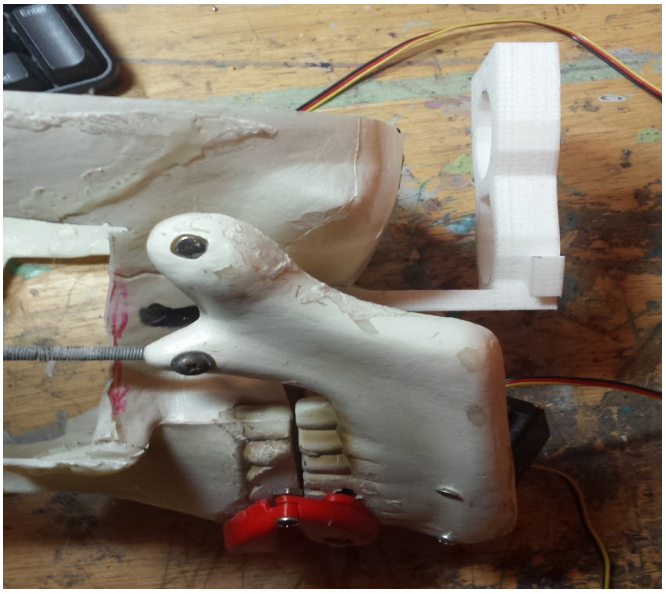
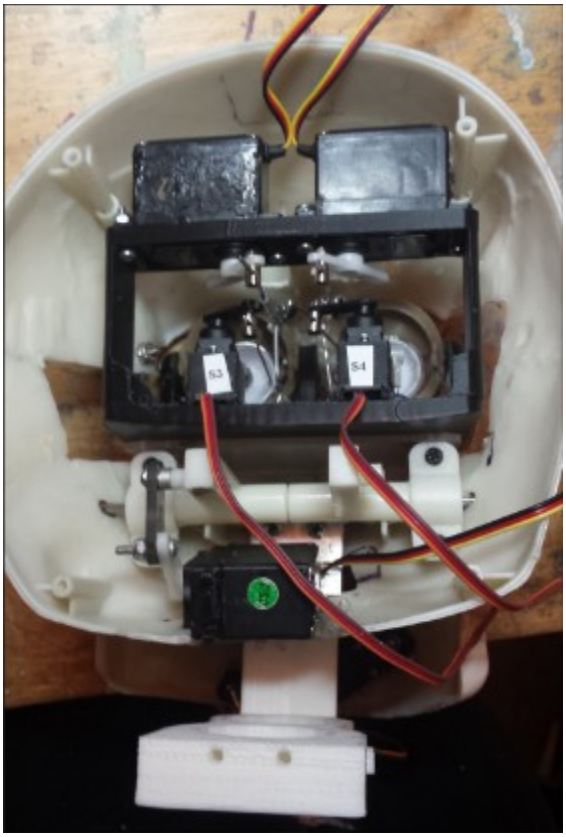


Fig. 11: InMoov neck attachment installed on the head.

My final task for the term was to find a way to install the internal eye/eyelid structure inside the head in such a way that it could be easily removed if necessary. I did this by creating a pexiglass mounting stage. The stage keeps the 3D printed structure flat and in place using screws to hold them together. It was necessary to drill holes in the top of the skull to allow for a long screwdriver to reach the

installation screws. These will be covered by the skin eventually and should not be an issue. The final results of my work through the term can be seen in the following images:



Next term the robot head will be handed off to the mask maker to begin the sculpting and skin making process. In that time I will work on the InMoov body, making repairs to the arms and gears so that once the head is finished, it can be installed on the body.